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**11 MONTHLY WEIGHT AND BALANCE REPORT
FOR THE APOLLO SPACECRAFT**

CONTRACT NAS 9-150

(U)

Paragraph 5.1 of Exhibit I NAS 9-150

1 NOVEMBER 1963



Prepared by

Weight Control

CLASSIFICATION CHANGE
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**NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION**

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~~CONFIDENTIAL~~INTRODUCTION

The November report reflects a spacecraft weight increase of 35 pounds at injection and 15 pounds at the injected spacecraft condition less Service Module propellant. The current injected weight of 84,575 pounds is based on a Service Module loaded with sufficient propellant at a specific impulse of 313.0 to provide 10 per cent ΔV margin. This is based on a LEM weight, including crew, of 25,000 pounds.

As was indicated previously, the Command Module weight has exceeded the proposed control weight of 9500 pounds. The reported weight is based on the definitions and released drawings for AFRM-011. A weight reduction program is under way to reduce the Command Module weight for the LOR mission. Center of gravity improvement is being considered concurrently.

The major changes in the Command Module were due to the addition of a Command Module vent and an increase in the electrical power batteries.

The major changes in the Service Module were due to a decrease in the aft heat shield structure and the addition of a sequencer to insure positive separation of the Command Module from the Service Module.

The major change in the Launch Escape System was due to a change in ballast consistent with the combined Launch Escape System and Command Module balance requirements.

The High Altitude Abort condition reflecting weight, center of gravity, and inertia has been altered to reflect a Launch Escape System Tower structure containing an aerodynamic tower flap which will be used in conjunction with the tower to stabilize the Command Module, blunt heat shield forward, during abort between the altitudes of approximately 30,000 feet to 220,000 feet.

The earth orbital mission weight summary reflects a two stage Booster-to-Orbit injection without the use of Service Module propulsion and is based on a complete Service Module loaded with 2425 pounds of propellant. The earth orbit weight reported limits the orbital altitude capability with the Saturn I Booster to 91.7 nautical miles. To obtain the 100 nautical mile orbital altitude with the Saturn I Booster will require off loading of the Command Module and Service Module.

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APOLLO LOR MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT. ²)		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	9730	1043.1	-0.1	7.8	4474	3919	3684
SERVICE MODULE - Less Propellant	9690	908.2	0.7	-0.6	6222	10321	10136
TOTAL - Less Propellant	19420	975.8	0.3	3.6	10771	33384	32891
PROPELLANT - S/M**	37295	905.9	5.6	-2.4	19162	19872	26398
TOTAL - With Propellant	56715	929.8	3.8	-0.3	30109	66819	72831
LUNAR EXCURSION MODULE	24460	623.0	0.0	0.0	13616	12776	13247
ADAPTER - LEM - C-5	3400	642.7	0.0	0.0	8372	12273	12273
TOTAL - Injected	84575	829.5	2.5	-0.2	52156	465833	472373
LAUNCH ESCAPE SYSTEM	7050	1299.1	0.0	-0.2	266	10961	10962
TOTAL - SPACECRAFT LAUNCH	91625	865.7	2.3	-0.2	52431	786479	793029

NOTES: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

**The propellant weight of 37295 pounds provides approximately 10% ΔV margin, and is determined from an estimated time line analysis. The propellant weight is based on a specific impulse of 313.0.

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APOLLO EARTH ORBIT MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*				MOMENTS OF INERTIA			(SLUG-FT. ²)
		X	Y	Z		ROLL (X)	PITCH (Y)	YAW (Z)	
COMMAND MODULE	9730	1043.1	-0.1	7.8		4474	3919		3684
SERVICE MODULE - Less Propellant	9690	908.2	0.7	-0.6		6222	10321		10136
TOTAL - Less Propellant	19420	975.8	0.3	3.6		10771	33384		32891
PROPELLANT - S/M**	2425	849.0	27.3	-11.5		815	444		564
TOTAL - With Propellant	21845	961.7	3.3	1.9		12031	41114		41274
ADAPTER - C-1	830	779.7	0.0	0.0		1029	753		753
TOTAL - Injected	22675	955.1	3.2	1.9		13062	47885		47747
LAUNCH ESCAPE SYSTEM	7050	1299.1	0.0	-0.2		266	10961		10962
TOTAL - Spacecraft Launch	29725	1036.7	2.4	1.4		13345	196253		196123

NOTES: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the Command Module substructure mold line.

**The earth orbital weights are based on a complete service module and includes 2425 pounds of propellant for an orbital altitude of about 91.7 nautical miles with a payload launch azimuth of 72°.

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APOLLO LAUNCH ABORT CONFIGURATION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT. ²)		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	9730	1043.1	-0.1	7.8	4474	3919	3684
LAUNCH ESCAPE SYSTEM	7050	1299.1	0.0	-0.2	266	10961	10962
TOTAL - Launch Abort	16780	1150.7	-0.1	4.4	4797	72763	72473
LESS - MAIN AND PITCH MOTOR PROPELLANTS	-3210	1296.5	0.0	0.0	-69	-1330	-1330
TOTAL - LES Burnout	13570	1116.2	-0.1	5.5	4711	53192	52920

NOTE: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

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COMMAND MODULE

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

LUNAR ORBIT RENDEZVOUS MISSION

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY			MASS INERTIA DATA (SLUG-FT. ²)					
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
EARTH LAUNCH	9730	1043.1	-0.1	7.8	4474	3919	3684	14	-206	-31
ADJUSTMENTS (NET)	+67									
Boost & Mission Coolants										
Food & Water Consumption										
Mission Waste Pickup										
Fuel Cell Water Pickup										
PRIOR TO ENTRY	9797	1042.7	0.0	7.9	4524	3962	3720	27	-228	-25
Less: Propellant	-270	1022.6	-5.1	56.6						
Ablator Burnoff	-223	1019.7	0.0	11.2						
Entry Coolant	-6	1022.6	-63.4	-16.4						
Forward Heat Shield	-325	1098.3	-0.1	3.4						
Drogue Chutes	-50	1090.0	0.0	-22.0						
PRIOR TO MAIN CHUTE DEPLOYMENT	8923	1041.6	0.2	6.7	4086	3352	3208	20	-137	-26
Less: Main Chutes (3)	-461	1089.9	0.3	6.7						
LANDING	8462	1039.0	0.2	6.7	4038	3088	2924	19	-137	-26

NOTE: Mass inertia data is shown for accumulative totals only.

COMMAND MODULE + LEV

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

HIGH ALTITUDE ABORT CONDITION

4 19 4

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY			MASS INERTIA DATA (SLUG-FT.2)					
		X	Y	Z	Lxx	Iyy	Izz	Lxy	Lxz	Iyz
COMMAND MODULE, LAUNCH	9730	1043.1	-0.1	7.8	4474	3919	3684	14	-206	-31
LEV Tower + Flap*	610	1144.6	0.0	-2.6						
Less: Boost Coolants	-14	1019.4	-51.0	-21.0						
C/M + LEV Tower	10326	1049.1	0.0	7.2	4568	5425	5173	11	-350	-34
Less: Propellant	-270	1022.6	-5.1	56.6						
Ablator Burnoff	-56	1019.7	0.0	11.2						
Entry Coolant	-6	1022.6	-63.4	-16.4						
LEV Tower + Flap*	-610	1144.6	0.0	-2.6						
Forward Heat Shield	-325	1098.3	-0.1	3.4						
Drogue Chutes	-50	1090.0	0.0	-22.0						
PRIOR TO MAIN CHUTE DEPLOYMENT	9009	1041.7	0.2	6.7	4141	3416	3269	3	-143	-36
Less: Main Chutes (3)	-461	1089.9	0.3	6.7						
LANDING	8548	1039.1	0.2	6.7	4094	3152	2986	3	-143	-36

NOTE: Mass inertia data is shown for accumulative totals only.

*Insulation burnoff unknown at this time.

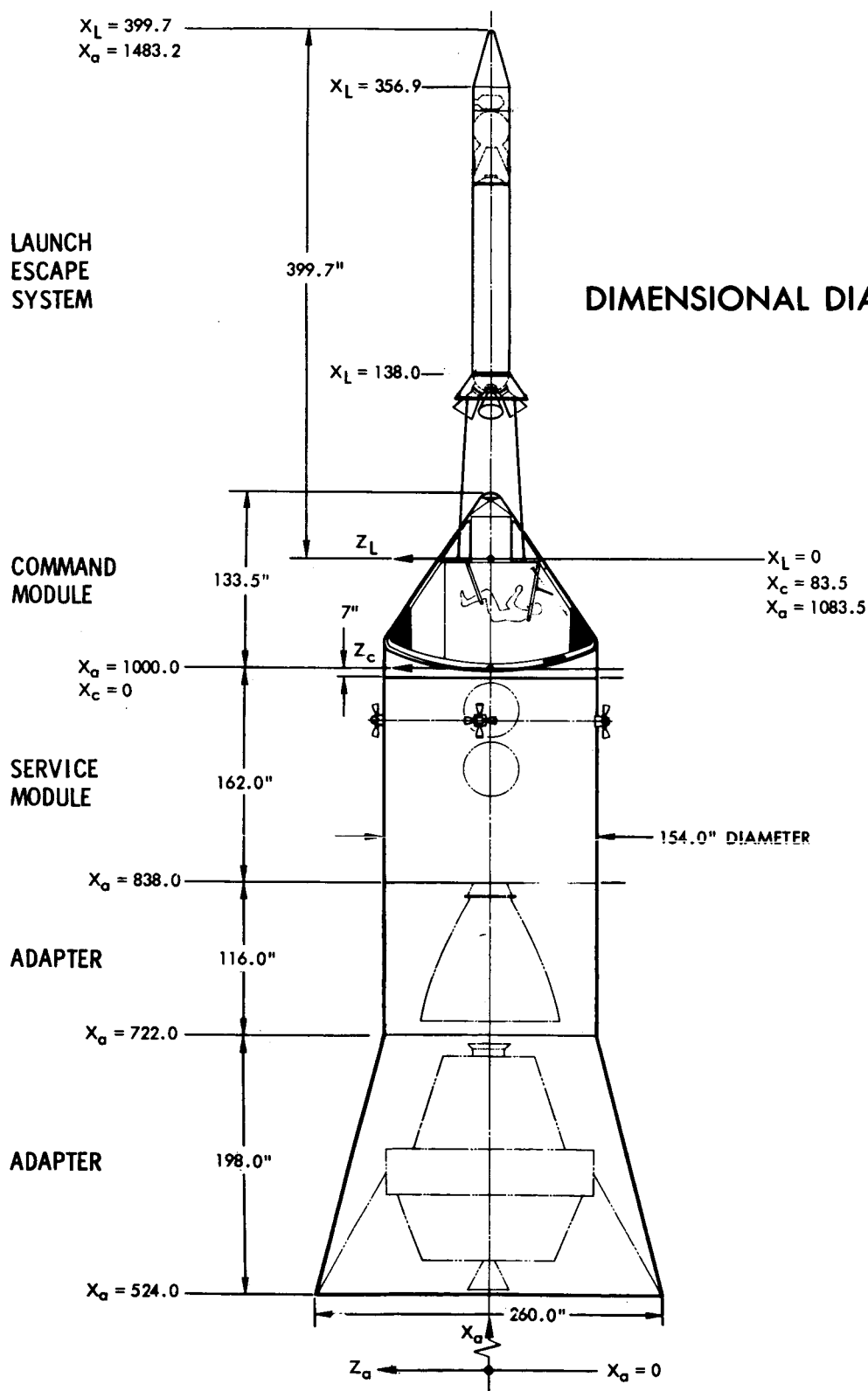
COMMAND MODULE

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

LOW ALTITUDE ABORT CONDITION

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY			MASS INERTIA DATA (SLUG-FT.²)						
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Izy	
EARTH LAUNCH	9730	1043.1	-0.1	7.8	4474	3919	3684	14	-206	-31	
Less: Propellant	-270	1022.6	-5.1	56.6							
Forward Heat Shield	-336	1098.3	-0.3	3.4							
Drogue Chute	-50	1090.0	0.0	-22.0							
PRIOR TO MAIN CHUTE DEPLOYMENT	9074	1041.4	0.0	6.7	4194	3448	3310	8	-119	-30	
Less: Main Chutes (3)	-461	1089.9	0.3	6.7							
LANDING	8613	1038.8	0.0	6.7	4147	3182	3024	7	-119	-30	

NOTE: Mass inertia data is shown for accumulative totals only.

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~~CONFIDENTIAL~~SPACECRAFTWEIGHT STATUS SUMMARY

ITEM	PREVIOUS STATUS 10-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 11-1-63	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
COMMAND MODULE	9700	+30	9730	51	47	2
SERVICE MODULE	46980	+5	46985	4	95	1
LES	7040	+10	7050	38	53	9
ADAPTER	3400		3400	100		
TOTAL	67120	+45	67165	19	79	2

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COMMAND MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 10-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 11-1-63	BASIS FOR CURRENT		
				% EST	% CAL	% ACT
Structure Structure - Less Ablator Ablation Material	(4545) 3231 1314	(+16) +16	(4561) 3247 1314	11 100	89	
Crew Systems	331	-33	298	99	1	
Communications	368	+24	392	92	8	
Instrumentation	193	-18	175	100		
Controls and Displays	281	+1	282	92	8	
Guidance and Navigation	425	-5	420	100		
Stabilization and Control	242	-22	220	99	1	
Reaction Control	328	-5	323	85	15	
Electrical Power	434	+54	488	86	14	
Environmental Control	283	+20	303	48	52	
Earth Landing	673		673	12	63	25
WEIGHT EMPTY	8103	+32	8135	53	45	2
Crew (3), (50, 70, 90 percentile)	528		528		100	
Crew System Equipment	296	-6	290	93	3	4
Food and Containers	90		90	100		
Reaction Control Propellant	270		270		100	
Environmental Control Chemicals	163	+4	167		100	
Scientific Payload	250		250	100		
GROSS WEIGHT	9700	+30	9730	51	47	2

~~CONFIDENTIAL~~COMMAND MODULECURRENT WEIGHT EMPTY CHANGESSTRUCTURE

(+16.0)

Increase Basic Body Structure Forward Section due to a redesign of the forward heat shield ejection fittings as a part of the solution to the gap problem.

+2.0

Decrease Basic Body Structure Center Section due to the following:

-1.0

Removal of bonded doubler from lower aft sidewall based on revised structural analysis.

-2.0

Revision of seals and hardware based on calculated in lieu of estimated weights.

+1.0

Increase Basic Body Structure Aft Section due to the addition of a fiberglass spacer on the aft bulkhead ring to facilitate mating of heat shield to basic body structure.

+2.0

Increase Secondary Structure due to the following:

+4.0

Increase of RH equipment bay based on calculation of released drawings in lieu of estimations.

+5.0

Decrease of forward RH equipment bay coldplate based on a reduced heat dissipation requirement resulting from the redesign of the inflight test system.

-7.0

Increase of lower equipment bay based on revised structure and coldplate requirements resulting from equipment relocation for CG improvement.

+6.0

Increase Heat Shield Substructure forward section due to a redesign of the aft ring as a part of the gap problem.

+4.0

Increase Heat Shield Substructure center section due to the following:

+2.0

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~~CONFIDENTIAL~~COMMAND MODULECURRENT WEIGHT EMPTY CHANGESSTRUCTURE (CONTINUED)

Increase of honeycomb panel due to the addition of lands to heat shield for mounting scimitar antennas.	+3.0
Decrease in forward ring due to redesign as a part of the solution to the gap problem.	-4.0
Transfer of umbilical provision to electrical power.	-9.0
Transfer of access doors for the RCS components from the Reaction Control System.	+5.0
Transfer of scimitar antenna provisions to communications.	-16.0
Addition of Command Module vent to vent the cavity space between the inner to outer structure to prevent possible structural failure which may occur due to the pressure differentials.	+23.0
Increase heat shield substructure aft section due to the following:	+3.0
Increase of panels based on calculations of corrected land widths.	+3.0

CREW SYSTEMS

(-33.0)

Decrease crew couch support and restraint system due to changing crew couch pads from insolite to a lighter density trilok.	-5.0
Addition of storage provision for constant wear garments.	+1.0
Addition of storage boxes for loose food packages.	+5.0
Transfer lighting equipment to Electrical Power System.	-10.3
Transfer waste management system less fecal canister and relief receptacle to Environmental Control System.	-23.7

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~~CONFIDENTIAL~~COMMAND MODULECURRENT WEIGHT EMPTY CHANGES

<u>COMMUNICATIONS</u>	(+24.0)
Increase antenna coax and connector weights based on calculations of the latest interconnection diagrams and cable drawings.	+8.0
Transfer antenna provisions from structure.	+16.0
<u>INSTRUMENTATION</u>	(-18.0)
Increase remote equipment due to the addition of a TV camera view finder.	+1.0
Decrease Inflight Test System per NASA direction to reduce comparators from 225 to 150.	-12.9
Decrease Inflight Test Electrical Provisions consistent with reduction of comparators.	-6.1
<u>CONTROLS AND DISPLAYS</u>	(+1.0)
Increase panels based on calculations of current drawings.	+1.9
Increase Navigation Display and Control based on current MIT report reflecting a revised estimate for the G & N navigation displays.	+1.0
Decrease manual rotational control due to using magnesium in lieu of aluminum for the structural parts per Minneapolis Honeywell.	- .9
Decrease manual translational control based on partial actual weights by Minneapolis Honeywell.	-1.0
<u>GUIDANCE AND NAVIGATION</u>	(-5.0)
Decrease spares based on current MIT report reflecting a revised quantity.	-6.0
Added coolant hoses to connect the Inertial Measurement Unit to the Command Module water glycol system per current MIT report.	+1.0

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COMMAND MODULECURRENT WEIGHT EMPTY CHANGESSTABILIZATION AND CONTROL

(-22.0)

Decrease Stabilization and Control System due to partial actual weights of components per latest Minneapolis Honeywell information as follows:

-22.0

Rate Gyro Package	+ .5
Body Mounted Gyro Package	+ .5
Electronic Control Package - Pitch	-5.1
Electronic Control Package - Roll	-5.0
Electronic Control Package - Yaw	-4.5
Electronic Control Package - Auxiliary	-4.8
Display/BMAG ECA Package	-3.6

REACTION CONTROL

(-5.0)

Transfer access doors for Reaction Control System components to heat shield substructure.

-5.0

ELECTRICAL POWER

(+54.0)

Increase re-entry and post landing batteries based on Eagle Pitcher's current status.

+13.5

Decrease DC power panel assembly based on calculations of released drawings.

-1.0

Increase circuit breaker panel based on calculations of released drawings.

+0.3

Transfer umbilical provisions from heat shield substructure.

+9.0

Increase left hand circuit breaker panel due to a change in gage thickness from .050 to .125 for rigidity and to match up with the other display panels. Redesign underway.

+3.0

Increase right hand circuit breaker panel due to a change in gage thickness from .050 to .125 for rigidity and to match up with the other display panels. Redesign underway.

+5.1

Decrease circuit utilization package due to current calculations based on released drawings.

-6.4

Transfer lighting equipment from crew systems.

+10.3

~~CONFIDENTIAL~~COMMAND MODULECURRENT WEIGHT EMPTY CHANGESELECTRICAL POWER (CONTINUED)

Increase sequencer based on calculation of released drawings
of the sequencer housing. +4.6

Increase sequencer due to change to implement EDS circuitry
agreement to change the automatic abort and engine shut-
down functions of the crew safety system EDS. +14.6

Increase common utility electrical transmission due to
addition of a side heat shield feed thru plate not previously
accounted for in the weight. +1.0

ENVIRONMENTAL CONTROL

(+20.0)

Decrease pressure suit circuit due to the following: -8.8

Reduction of CO₂ and odor absorber housing
based on partial actual weights of hardware
as reported by AiResearch. -2.5

Reduction in ducting due to relocation of suit
circuit umbilical connection eliminating a
long run of ducting. -6.3

Decrease water glycol circuit based on AiResearch status
reflecting calculations of detail production drawings. -0.7

Increase oxygen system due to calculation of oxygen surge tank
based on released drawings. +0.9

Increase pressure and temperature control circuit based on
AiResearch status reflecting an addition of a cabin air
outlet valve not previously accounted for in their weights. +0.8

Increase water supply system based on AiResearch report
reflecting an increase in the potable water tank due to the
addition of a sleeve around the bladder and an increase in
the waste water tank due to the addition of a control
necessary to control and measure the volume of liquid in
the tanks. +3.6

Transfer waste management system from Crew Systems. +24.2

TOTAL COMMAND MODULE CURRENT WEIGHT EMPTY CHANGES

-32.0~~CONFIDENTIAL~~

~~CONFIDENTIAL~~COMMAND MODULECURRENT USEFUL LOAD CHANGES

<u>CREW SYSTEMS</u>	(-6.0)
Decrease portable life support system due to removal of primary oxygen.	-0.9
Decrease crew survival kit due to deletion of personal preference items and removal of food.	-4.5
Increase personal hygiene equipment due to addition of storage baskets.	+3.4
Transfer chemical disinfectant to Environmental Control.	-4.0
<u>ENVIRONMENTAL CONTROL</u>	(+4.0)
Transfer chemical disinfectant from Crew Systems.	+4.0
<hr/>	
TOTAL COMMAND MODULE CURRENT USEFUL LOAD CHANGES	-2.0

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SERVICE MODULE WEIGHT STATUS

ITEM	PREVIOUS STATUS 10-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 11-1-63	BASIS FOR CURRENT		
				% EST	% CAL	% ACT
Structure	2265	-55	2210	12	73	15
Electronics	177		177	100		
Reaction Control	580		580	61	39	
Electrical Power	1339	+24	1363	13	60	27
Environmental Control	92		92	19	77	4
Propulsion System	(3022)	(+16)	(3038)	82	18	
Engine Installation	715	+16	715	13	87	
Propulsion System	2307		2323			
WEIGHT EMPTY	7475	-15	7460	25	66	9
RCS Propellant	838		838		100	
Electrical Power Supercritical Fluids	503		503		100	
Environmental Control Supercritical Fluids	208		208		100	
Main Propulsion Helium	99		99		100	
Main Propellant Residuals	(582)		(582)		100	
Trapped - System	225		225			
Trapped - Engine	67		67			
Mixture Ratio Tolerance	100		100			
Loading Tolerance	190		190			
BURNOUT WEIGHT	9705	-15	9690	19	74	7
Main Propellant	37275	+20	37295		100	
GROSS WEIGHT	46980	+5	46985	4	95	1

~~CONFIDENTIAL~~SERVICE MODULECURRENT WEIGHT EMPTY CHANGES

<u>STRUCTURES</u>	(-55.0)
Replace aluminum honeycomb sandwich in the Aft Heat Shield with stiffened fiberglass sheet.	-55.0
<u>ELECTRICAL POWER SYSTEM</u>	(+24.0)
Fuel cell H ₂ and O ₂ plumbing revised per calculated weight and reallocation.	-0.5
Electrical Common Utility	+24.5
Added sequencer and necessary wiring for control of RCS engines to insure positive separation of the Command Module - Service Module.	+23.0
Command Module to Service Module separation system increased per weight calculations.	+0.2
Provisions - Miscellaneous design changes.	+1.3
<u>MAIN PROPULSION</u>	(+16.0)
Oxidizer System tanks increase resulted from an increase in door flange area.	+6.0
Pressure System H ₂ tanks increase resulted from increase in weld flanges and changing the density of titanium from .160 pounds/cu. in. to .161 pounds/cu. in. per Material and Producibility Group.	+10.0
 TOTAL SERVICE MODULE CURRENT WEIGHT EMPTY CHANGES	 -15.0

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~~CONFIDENTIAL~~LAUNCH ESCAPE SYSTEMWEIGHT STATUS

	PREVIOUS STATUS 10-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 11-1-63	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
Structure	1062		1062	9	75	16
Electrical System	58		58	100		
Propulsion System						
Main Thrust	4764		4764	40	60	
Jettison	434		434			100
Jettison Motor						
Skirt	92		92			100
Pitch Control	55		55	60	40	
Separation Provisions	67		67	61	39	
LES - NO BALLAST	6532		6532	33	57	10
BALLAST	508	+10	518	100		
TOTAL L.E.S.	7040	+10	7050	38	53	9

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~~CONFIDENTIAL~~LAUNCH ESCAPE SYSTEMCURRENT WEIGHT CHANGESBALLAST

(+10)

Increase ballast consistent with combined Launch Escape
System and Command Module balance requirements.

+10

TOTAL LAUNCH ESCAPE SYSTEM CURRENT WEIGHT CHANGES

+10

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~~CONFIDENTIAL~~ADAPTERWEIGHT STATUS

ITEM	PREVIOUS STATUS 10-1-63	CHANGE TO CURRENT	CURRENT WEIGHT 11-1-63	BASIS FOR CURRENT		
				%EST	%CAL	%ACT
Structure	3070		3070			
Electrical	80		80			
Separation System	250		250			
TOTAL ADAPTER	3400		3400	100		

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~~CONFIDENTIAL~~WEIGHT HISTORY COMMENTS**LAUNCH ESCAPE SYSTEM**

The design goal established for the LES is 6,300 pounds, excluding ballast. This weight was based on the September 1962 status weight of 6,600 pounds, including the necessary ballast to provide currently determined aerodynamic stability to prevent tumbling.

The original design goal of 5,900 pounds, as reported in the June status, SID 62-99-5, was based on an attitude controlled configuration. The current configuration weight includes a pitch motor and ballast not included in the original target weight.

COMMAND MODULE

The design goal established for the Command Module is 8,500 pounds. An estimated weight breakdown for the design goal is provided for comparative purposes.

The original design goal weight of 8,340 pounds, as reported in the June status, SID 62-99-5, did not include the proposed increases nor the Category I reductions presented in the July briefing and incorporated in the July Status Report.

SERVICE MODULE

The design goal established for the Service Module less usable propellant is 11,000 pounds. An estimated weight breakdown for the design goal is provided for comparative purposes. This configuration is sized for 45,000 pounds usable propellant for the 25,000 pound LEM.

The original design goal weight of 8,595 for the burnout condition was based on a lunar configuration sized for 31,000 pounds usable propellant.

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~~CONFIDENTIAL~~WEIGHT HISTORYCOMMAND MODULE

	DESIGN GOAL	AUTHORIZED CHANGES	DESIGN GOAL ADJUSTED 11-1-63
Structure	3824	+125	3949
Crew Systems	530		530
Communication	330	+ 33	363
Instrumentation	173	+7	180
Controls & Displays	261	+3	264
Guidance & Navigation	261	+159	420
Stabilization & Control	181		181
Reaction Control	195		195
Electrical Power	390	+11	401
Environmental Control	235	-12	223
Earth Landing	610		610
WEIGHT EMPTY	6990	+326	7316
Crew	528		528
Suits & Personal Equipment	304	-8	296
Food & Containers	90		90
Reaction Control Propellant	210		210
Environmental Control Fluids	128		128
Scientific Payload	250		250
GROSS WEIGHT	8500	+318	8818

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~~CONFIDENTIAL~~COMMAND MODULE WEIGHT HISTORYWEIGHT EMPTY AUTHORIZED CHANGES

STRUCTURE	(+125)
Change parachute attach to a two leg configuration for incorporation of the "Tumbling Concept" at earth impact attenuation. (CCA No. 93)	+125
COMMUNICATIONS	(+33)
Add a spacecraft up-data link for the purpose of providing current GOSS data within the spacecraft for display and comparison with the on-board computed data. (CCA No. 54).	+35
Change the present two speed data storage to a three speed machine to provide fast dump of data. (CCA No. 59)	-2
INSTRUMENTATION	(+7)
Increase the PCM output bit rate from 31,000 to 51,200 bit/sec. This change was originally considered to have negligible weight affect but has henceforth been reported by Collins to cause a seven pound increase. (CCA No. 44)	+7
CONTROLS & DISPLAYS	(+3)
Furnish and install a clock timer panel at the navigation station lower equipment bay. (CCA No. 84)	+2
Increase G&N navigation controls coded to Controls & Displays per M.I.T. status.	+1
GUIDANCE & NAVIGATION	(+159)
Increase the Guidance and Navigation per recent weight report from M.I.T. Since NAA does not have weight control responsibility for the M.I.T. design, the weight changes in their Weight and Balance Report will be considered as authorized changes.	+159
ELECTRICAL POWER	(+11)
Add two batteries to provide a source of power, separate from the primary D.C. power, to initiate pyrotechnic devices. (CCA No. 28).	+10
Add PLSS battery charging control to prevent overcharging battery. (CCA No. 82)	+1

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~~CONFIDENTIAL~~COMMAND MODULE WEIGHT HISTORYWEIGHT EMPTY AUTHORIZED CHANGES

ENVIRONMENTAL CONTROL	(-12)
Add a CO ₂ sensor to the ECS as a part of the ECS operational instrumentation. (CCA No. 43)	+2
Add a surge tank to ECS and delete entry oxygen supply to provide early mission emergency gas flows. (CCA No. 52)	-7
Deletion of regenerative heat exchanger from the ECS heat exchanger package. (CCA No. 63)	-7
	<hr/>
TOTAL COMMAND MODULE WEIGHT EMPTY CHANGES	+326

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~~CONFIDENTIAL~~COMMAND MODULE WEIGHT HISTORYUSEFUL LOAD AUTHORIZED CHANGES

SUITS & PERSONAL EQUIPMENT

(-8)

Change the following GFE (NASA) responsibility items:

Increase personal radiation dosimeters per NASA Crew Systems Meeting Number 19, Action Item Number 6.	+10
Increase PLSS per Hamilton Standard status.	+36
Delete initial charge water for coolant, from PLSS, as this item is now carried in the potable water tank.	-5
Delete one PLSS consistent with requirements for LOR mission.	-48
Delete primary oxygen from remaining PLSS	-1

TOTAL COMMAND MODULE USEFUL LOAD CHANGES

-8~~CONFIDENTIAL~~

~~CONFIDENTIAL~~WEIGHT HISTORYSERVICE MODULE

	DESIGN GOAL	AUTHORIZED CHANGES	DESIGN GOAL ADJUSTED 11-1-63
Structure	3203		3203
Electronics	145		145
Reaction Control	737		737
Electrical Power	1203		1203
Environmental Control	250		250
Propulsion System			
Engine Installation	606		606
Propellant System	2456		2456
WEIGHT EMPTY	8600		8600
Usable RCS Propellant	611		611
Usable Fuel Cell Reactants	479		479
Environmental Control Fluids	193		193
Main Propulsion Helium	139		139
Main Prop. Residuals	900		900
Unusable RCS Propellant	61		61
Unusable Fuel Cell Reactants	17		17
BURNOUT WEIGHT	11000		11000
Main Propellant	45000		45000
GROSS WEIGHT	56000		56000

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~~CONFIDENTIAL~~POTENTIAL WEIGHT AND CENTER OF GRAVITY CHANGESCOMMAND MODULE

<u>STRUCTURE</u>	(-72)
Addition of crushable HCB core installation in aft compartment.	+25
Incorporation of oxidizer dump in aft heat shield.	+3
Reduction of heat shield window glass thickness from 0.70 to 0.55 inches.	-10
Main parachute yoke installation study.	-10
Refinement of structure beyond AFRM O11.	-100
Increase in aft equipment bay due to electronic component storage compartments.	+20
<u>CREW SYSTEMS</u>	(-154)
Change in crew and metabolic criteria based on astronaut data and new NASA metabolic rates.	
Crew	-49
Food and Containers	-12
Reduce life rafts.	-9
Reduce or eliminate portable light.	-3
Increase crew couch attenuation.	+21
Delete requirement for the PLSS as there is no extra vehicular missions planned from the Command Module.	-45
Decrease mission duration from 14 days to 8 days:	
Food and Containers	-38
Chemical Disinfectant	-2
Personal Hygiene Equipment	-4
Remove thermal coveralls.	-13

**CONFIDENTIAL**POTENTIAL WEIGHT AND CENTER OF GRAVITY CHANGESCOMMAND MODULE

<u>COMMUNICATION & INSTRUMENTATION</u>	(-7)
Repackage PCM components.	-18
Add electrical provisions for test instrumentation to monitor C-1 and C-5 booster per NASA.	+16
Utilize Conic Corporation VHF/FM and unmodular HF.	-8
Add provisions for flight qualification PCM.	+10
Utilize Rantec multiplexer.	-7
<u>STABILIZATION & CONTROL</u>	(-40)
Decrease SCS packages per M-H weight reduction study including design refinements such as machining base plates, reducing potting and optimizing side panels.	-40
<u>REACTION CONTROL SYSTEM</u>	(+2)
Propellant tank increase.	+2
<u>ELECTRICAL POWER SYSTEM</u>	(+76)
Delete battery charger for PLSS.	-1
Decrease battery charger.	-1
Increase electrical wiring.	+100
Decrease inverters due to redesign of power transistors.	-14
Redesign circuit breaker panel structure.	-8
<u>ENVIRONMENTAL CONTROL SYSTEM</u>	(-116)
Reduce water-glycol plumbing gage from .035 to .020.	-3
Reduce lithium hydroxide and containers per change in Crew and Metabolic criteria based on astronaut data and new NASA metabolic rates.	-18
Reduce quantity requirements of lithium hydroxide due to mission duration decrease from 14 days to 8 days.	-55

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POTENTIAL WEIGHT AND CENTER OF GRAVITY CHANGES

COMMAND MODULE

ENVIRONMENTAL CONTROL SYSTEM (CONTINUED)

Change in 78g requirements to comply with structure criteria (AiResearch items).	-8
Addition of third glycol pump and coldplate redundancy.	+10
Change from aluminum to magnesium on some AiResearch components.	-7
Addition of pressure transducer, two check valves and two shut-off valves to O ₂ surge tank.	+2
Combine potable and waste water tanks.	-4
Investment castings in lieu of precision sand castings on suit compressor and glycol pump.	-5
Delete two lithium hydroxide charges by raising the maximum allowable CO ₂ content.	-9
Combining AiResearch components.	-7
Addition of radiator controller.	+6
Simplified ECS water management, cooling system, and deletion of freon system.	-11
Delete recharging provisions for PLSS.	-9
Addition of O ₂ surge tank instrumentation (NASA requirement per letter 9569 MA, dated July 23, 1963).	+2

EARTH LANDING SYSTEM (-25)

Main parachute yoke installation.	-25
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LEM INTEGRATION (+166)

Modify structure to incorporate mating and locking capabilities and to strengthen hatch for impact loads.	+150
Add rendezvous beacon radar installation as an aid during the rendezvous phase.	+16

~~CONFIDENTIAL~~POTENTIAL WEIGHT AND CENTER OF GRAVITY CHANGESCOMMAND MODULESCIENTIFIC EQUIPMENT

(-170)

Remove from Lower Equipment Bay.

-35

Remove from Right Hand Equipment Bay.

-135

TOTAL POTENTIAL CHANGES, COMMAND MODULE

-340~~CONFIDENTIAL~~

~~CONFIDENTIAL~~POTENTIAL WEIGHT AND CENTER OF GRAVITY CHANGESSERVICE MODULESTRUCTURE

(+44)

Remove outer face sheet for increased EPS radiator area.	-5
Increase insulation weight in the area of the aft heat shield due to the following:	+49
Increase the density of Q-felt insulation from 3.5 lbs./ft. ³ to 6.0 lbs./ft. ³ .	+14
Increase the density of NRC-2 insulation from 3.5 lbs./ft. ³ to 4.7 lbs./ft. ³ .	+2
Increase insulation support requirements.	+8
Increase area of Q-felt insulation due to engine heat requirements.	+25

ELECTRICAL POWER

(-355)

Revise the Supercritical Gas Storage System, based on coordination with the subcontractor (Beech Aircraft), to include the following changes:	-25
Reduction of insulation preloading from 2 to $\frac{1}{2}$ psi, H ₂ tank.	-7
Fan heaters in lieu of electrofilm heaters cryogenic.	-20
Sculpturing material on complete system.	-13
Reduction in titanium stress allowable.	+15
Reduce H ₂ for 8 day mission in lieu of 14 day.	-12
Reduce O ₂ for 8 day mission in lieu of 14 day.	-280
Decrease in Fuel Cell Power System, based on Pratt & Whitney's weight report reflecting the following:	-38
Compact Secondary Regenerator	-7
Unitized Gas Manifolds	-6
Close control of electrode filling techniques	-10
Thinner electrode spacing	-15

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~~CONFIDENTIAL~~POTENTIAL WEIGHT AND CENTER OF GRAVITY CHANGESSERVICE MODULEENVIRONMENTAL CONTROL

(+87)

Add provisions for nitrogen purging of the Service Module to prevent accidental explosion on the pad.

+15

Addition of radiator controller.

+2

Addition of propellant heating system to maintain fuel at temperature above freezing point.

+70

LEM INTEGRATION

(+210)

Structural beef-up of Radial Beam No. 4 to mount Radar Transponder.

+5

Structural beef-up of Forward Bulkhead and Fairing for mounting for VHF and X-Band Omni Antennas.

+10

Add supports to the aft bulkhead to mount deployable radar antenna.

+20

Add insulation to cover transponder and antennas.

+5

Add rendezvous radar equipment.

+170

TOTAL POTENTIAL WEIGHT CHANGES - SERVICE MODULE

-14

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULESUMMARY

ITEM		CURRENT WEIGHT 11-1-63
<u>WEIGHT EMPTY</u>		8135
Structure	4561	
Crew Systems	298	
Communications	392	
Instrumentation	175	
Controls & Displays	282	
Guidance & Navigation	420	
Stabilization & Control	220	
Reaction Control	323	
Electrical Power	488	
Environmental Control	303	
Earth Landing	673	
<u>USEFUL LOAD</u>		1595
Crew Systems	908	
Reaction Control	270	
Environmental Control	167	
Scientific Payload	250	
GROSS WEIGHT		9730

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DETAIL WEIGHT STATEMENT
COMMAND MODULE
STRUCTURE

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ITEM	CURRENT WEIGHT 11-1-63
<u>STRUCTURE</u>	
Basic Body Structure	(1045)
Forward Section	183
Honeycomb	56
Frames, Rings and Hatches	57
Fittings and Attachments	70
Center Section	667
Honeycomb Panels	208
Longerons, Frames and Rings	263
Window and Hatches	106
Fittings and Attachments	90
Aft Section	195
Honeycomb Panel	116
Ring	79
Secondary Structure	(572)
RH Equipment Bay and Coldplates	79
LH Equipment Bay	86
Fwd. LH Equipment Bay	20
Fwd. RH Equipment Bay and Coldplates	13
Main Display Panel and Coldplates	66
Lower Equipment Bay and Coldplates	203
Aft Equipment Bay	44
Crew Area	20
Heat Shield Equipment Area	41
Heat Shield Substructure	(1413)
Forward Section	193
Honeycomb Panels	108
Frames and Rings	35
Fittings and Mechanism	50
Center Section	691
Honeycomb Panels	241
Frames and Rings	107
Doors and Covers	186
Fittings, Mechanism and Attachments	134
Air Vent	23
Aft Section	529
Honeycomb Panels	361
Frames and Rings	47
Fittings and Attachments	81
Toroidal Assembly	40
Ablation Material	(1314)
Forward Section	139
Center Section	577
Aft Section	598
Insulation	(195)
Separation Provisions and Attachments	(22)
 TOTAL STRUCTURE	 4561

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DETAIL WEIGHT STATEMENT
COMMAND MODULE
CREW SYSTEMS

ITEM	CURRENT WEIGHT 11-1-63
<u>CREW SYSTEMS</u>	
Crew Couch Support and Restraint System	26.0
Waste Management	2.1
Egress Accessories - Hatch	3.0
Case Assembly - Map and Manual	2.0
Structural Seats and Supports	258.0
Shelf Assy. - Work/Food Preparation	1.9
Food Storage Boxes	5.0
<hr/>	
TOTAL CREW SYSTEMS	298.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULECOMMUNICATIONS

ITEM	CURRENT WEIGHT 11-1-63
<u>COMMUNICATIONS</u>	
Lower Bay	(239.1)
C-Band Transponder	20.8
Unified S-Band	25.0
S-Band Power Amplifier	20.5
VHF FM Transmitter/HF Transceiver	15.9
VHF AM Trans.-Rec/VHF Rec. Bea.	14.0
Multiplexer	11.0
Spares	19.0
Signal Conditioner	32.8
Recorder	25.4
Audio Center	8.0
Premodulation Processor	11.2
Central Timing Equipment	8.0
Up Data Link and Provisions	25.0
VHF-HF Diplexer	1.7
VHF-UHF Diplexer	.8
Remote Equipment	(57.9)
VHF-HF Recovery Antenna & Transmission	11.4
C-Band Antenna & Transmission	11.7
2-KMC High Gain Antenna and Transmission	4.4
VHF-2KMC Omni Antenna, Transmission & Inst. Prov.	30.4
Electrical Provisions	(95.0)
Electrical Wiring	79.7
Data Distribution Panel	4.0
Coax	5.2
Connectors	6.1
TOTAL COMMUNICATIONS	392.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULEINSTRUMENTATION

ITEM	CURRENT WEIGHT 11-1-63
<u>INSTRUMENTATION</u>	
Lower Equipment Bay	(58.0)
PCM Unit No. 1	26.2
PCM Unit No. 2	20.8
Nuclear Radiation Detection Equipment	11.0
Remote Equipment	(47.0)
Sensors	35.0
Nuclear Radiation Detection Provisions	6.0
TV Camera & Lens	4.5
TV Viewfinder	1.5
Right Hand Bay Forward	(36.1)
Inflight Test System	
Comparators and Power Supply	16.5
Lamps	1.9
Switches	1.5
Meter	1.0
Chassis	9.1
Harness	4.1
Access Cable	2.0
Electrical Provisions	(33.9)
Inflight Test Electrical Provisions	30.0
Data Distribution Panel	3.9
<hr/>	
TOTAL INSTRUMENTATION	175.0

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DETAIL WEIGHT STATEMENT
COMMAND MODULE
CONTROLS AND DISPLAYS

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ITEM	CURRENT WEIGHT 11-1-63
MAIN DISPLAY PANEL	
Main Display Panel Control Station	(52.8)
SCS Mode Select	5.7
Delta Velocity	3.8
Flight Director Attitude Indicator	11.5
Attitude Set and Gimbal Position Display	7.6
Entry Monitoring Indicator	15.0
Launch Vehicle Emergency Detection System C-1	3.9
Master Caution and Abort Lt.	.3
IFTS Switch	.1
Barometric Indicator	1.8
Event Timer	1.5
Mounting Panels	1.6
Main Display Panel Center Station	(60.3)
Audio Panel	1.7
Abort Light	.2
Reaction Control	10.8
GMT Readout	.8
ECS Gages and Controls	7.2
Crew Safety Controls	1.6
High Gain Antenna Control	2.6
G & N Computer Keyboard	15.0
Radiation Displays	3.0
Cryogenic	6.4
Caution and Warning Display	4.8
Mounting Panels	6.2
Main Display Panel System Management Station	(29.0)
Communications Control Panel	4.8
Master Caution Lights	.1
Power Distribution	6.7
Fuel Cells Controls	4.4
Service Propulsion	8.1
IFTS Switch	.1
Oxygen Warning	.1
Mounting Panels	4.7
Main Display Panel RH Console	(10.0)
Bus Switches	5.4
Audio Panel	1.8
Lighting Control	1.1
Mounting Panels	1.7
Main Display Panel LH Console	(7.0)
Mission Sequence Controls	1.0
Lighting Control	1.1
Audio Panel	1.8
SCS Power Control	1.3
Mounting Panels	1.8
TOTAL MAIN DISPLAY PANEL (To be brought forward)	159.1

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

CONTROLS AND DISPLAYS

ITEM	CURRENT WEIGHT	11-1-63
REMOTE EQUIPMENT		
Lower Equipment Bay		(51.4)
Lighting Control Panel		1.2
G & N Controls and Displays		50.2
Map and Data Viewer	8.5	
Display and Control - Navigation	26.7	
Display and Control - Computer	15.0	
Left Hand Forward Equipment Bay		(1.8)
Clock		.8
Event Timer		.8
Mounting Panel		.2
Crew Area Controls		(22.5)
Manual Control - Rotation		13.3
Manual Control - Translational		9.2
Caution and Warning		(16.5)
Detector		14.0
Spares		2.5
Electrical Provisions		(30.7)
Electrical Wiring		29.0
SCS/G & N Display Junction Box		1.7
TOTAL REMOTE EQUIPMENT		122.9
TOTAL MAIN DISPLAY PANEL		159.1
TOTAL CONTROLS AND DISPLAYS		282.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEGUIDANCE & NAVIGATION

ITEM	CURRENT WEIGHT 11-1-63
<u>GUIDANCE AND NAVIGATION</u>	
Electronic Equipment	(280.7)
Inertial Measurement Unit	59.0
Navigation Base	27.2
Computer & Spare Tray	70.0
Computer Stored Spares	26.5
Power Servo Assembly	56.7
Coupling Display Unit	16.5
Junction Box	12.2
Bellows Assembly	12.6
Optical Equipment	(45.8)
Sextant	12.0
Telescope	9.0
Optical Base	21.0
Optical Eyepieces	3.8
Loose Stored Items	(41.5)
Film Cartridges (4)	3.0
Computer Self Check Plug	1.0
Computer Loose Spares	17.0
Power Servo Assembly Loose Spares	11.5
CDU Spare Gear Box	3.0
Spare Relay & Diode Module	.3
Spare Lamps (3)	.2
Eye Relief Eyepiece	1.5
Horizon Photometer	4.0
Electrical Provisions	(51.0)
Cabling MIT	35.0
Cabling NAA	16.0
Coolant Hoses	(1.0)
 TOTAL GUIDANCE AND NAVIGATION	 420.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULESTABILIZATION AND CONTROL

ITEM	CURRENT WEIGHT 11-1-63
<u>STABILIZATION AND CONTROL</u>	
Lower Equipment Bay	(202.5)
Rate Gyro Package	7.6
Body Mounted Gyro Package	12.9
Electronic Control Package - Pitch	31.6
Electronic Control Package - Roll	31.4
Electronic Control Package - Yaw	32.2
Electronic Control Package - Auxiliary	31.4
Display/BMAG ECA Package	40.9
Spare Gyro - BMAG (2)	2.0
Spare Gyro - Rate	.5
Spare Plug-in Module	12.0
Electrical Provisions	(17.5)
Wiring, etc.	16.0
SCS Power Junction Box	1.5
TOTAL STABILIZATION AND CONTROL	220.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEREACTION CONTROL SYSTEM

ITEM	CURRENT WEIGHT 11-1-63
<u>REACTION CONTROL SYSTEM</u>	
Propellant Systems	(74.6)
Oxidizer System	37.2
Tanks & Expulsion Devices	15.0
Plumbing, Fittings & Insulation	11.4
Valves & Regulators	10.3
Sensors	.5
Fuel System	37.4
Tanks & Expulsion Devices	15.2
Plumbing, Fittings & Insulation	11.4
Valves & Regulators	10.3
Sensors	.5
Pressure System	(55.4)
Tanks (4500 psi)	9.5
Plumbing, Fittings & Insulation	4.8
Valves & Regulators	38.6
Sensors	2.5
Engine System	(138.0)
Engines	96.0
Nozzle Extension	42.0
Electrical Provisions	(23.0)
Dumping System	(32.0)
Valves & Supports	13.0
Controls & Electrical Provisions	12.0
Plumbing & Fittings	5.0
Miscellaneous	2.0
TOTAL REACTION CONTROL SYSTEM	323.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEELECTRICAL POWER

ITEM	CURRENT WEIGHT 11-1-63
<u>ELECTRICAL POWER</u>	
Energy Source	(77.5)
Battery - Re-entry (2)	45.0
Battery - Post Landing (1)	22.5
Battery - Pyrotechnic - Installation	10.0
Power Conversion	(117.0)
Inverter (3) & Control	111.0
Battery Charger & Controls	5.0
PLSS Battery Charging System	1.0
Power Distribution & Control	(94.1)
D-C Power Panel Assy	7.6
A-C Power Box Assy	11.1
Battery Circuit Breaker Panel	3.4
Lower Equipment Bay Panel	5.1
Terminal Distribution Panel (Bus)	9.0
Circuit Breaker Panel	4.3
Electrical Transmission (Wiring, Connectors, Cond., Sup.)	34.6
Ground Power Provisions	6.0
Power Control Panel Connectors	3.0
Installation Provisions	10.0
Electrical Common Utility	(199.4)
Electrical Transmission (Wiring, Conn., Cond., & Sup.)	86.9
Right Hand Circuit Breaker Panel	16.0
Left Hand Circuit Breaker Panel	10.5
Lighting Equipment	10.3
Lighting	5.0
Adapter Separation System	5.0
LES Separation System	3.5
S/M Pyrotechnic Initiation	3.0
Circuit Utilization Package	6.4
Sequencer	39.2
Installation Provisions	13.6
 TOTAL ELECTRICAL POWER	 488.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEENVIRONMENTAL CONTROL SYSTEM

ITEM	CURRENT WEIGHT 11-1-63
<u>ENVIRONMENTAL CONTROL SYSTEM</u>	
Pressure Suit Circuit	(77.1)
Subcontractor Compressor, Heat Exchg., Val. & Cont.	68.6
Ducting, Conn., Clamps, etc.	6.5
CO ₂ Sensor	2.0
Water-Glycol Circuit	(58.4)
Subcontractor Res., Evaporator, Pump, Val. & Cont.	27.5
Water-Glycol	18.4
Plumbing, etc.	12.5
Pressure & Temp. Control	(19.0)
Subcontractor Heat Exchg., Blower, Val. & Cont.	18.2
Ducting	0.8
Oxygen Supply System	(16.0)
Subcontractor Entry O ₂ Sys., Val. & Cont.	4.8
Plumbing	4.0
Oxygen Surge Tank	7.2
Water Supply System	(42.2)
Subcontractor Potable & Waste Tanks & Freon Tank	30.5
Plumbing	11.7
Waste Management System	(24.2)
Subcontractor Common Items	(25.8)
Brackets, Plumbing, Elect. Wiring	11.5
Instrumentation	14.3
Supports	(12.9)
Electrical Provisions	(21.0)
Manual Controls - Push Pull	(3.6)
N ₂ Purge System	<u>(2.8)</u>
TOTAL ENVIRONMENTAL CONTROL SYSTEM	303.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEEARTH LANDING SYSTEM

ITEM	CURRENT WEIGHT 11-1-63
<u>EARTH LANDING SYSTEM</u>	
Parachute System	(606.3)
Drogue Chute System	70.0
Main Cluster	451.7
Disconnect Main Cluster	3.1
Pilot Chute System	28.9
Sequence Control	11.2
Attach Provisions	41.4
Location Aids	(6.3)
Forward Heat Shield Release System	(45.4)
Drogue Disconnect Installation	(9.0)
Electrical Pyrotechnic Initiation Provisions	<u>(6.0)</u>
TOTAL EARTH LANDING SYSTEM	673.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEUSEFUL LOAD

ITEM	CURRENT WEIGHT 11-1-63
<u>CREW SYSTEMS</u>	
Government Furnished Equipment	(157.9)
Pressure Garment Assembly (3)	90.0
Portable Life Support System (1)	42.1
Garments - Constant Wear	9.0
Biomedical Instrumentation	2.0
Personal Radiation Dosimeters	14.8
Crew (50, 70, 90 Percentile)	(528.0)
Food and Associated Equipment	(93.5)
Food	75.0
Food Containers	15.0
Food Mouthpiece - Personal	2.0
Water Delivery Assembly - Personal	1.5
Crew Accessories	(8.0)
Lap Board Assembly	2.0
Manual Set	3.0
Map Set	1.0
Logbook Assembly	1.0
Tool Set - Inflight Maintenance	1.0
Crew Equipment	(26.2)
Shoe Straps	2.0
Hose Assembly - Umbilical	17.9
Belt Assembly - Inflight Maintenance	1.0
Hose Assembly - Recharging, Backpack	2.8
Suit Electrical Umbilical and Wire	2.5
Waste Management	(3.2)
Medical Equipment	(15.3)
Personal Hygiene Equipment	(18.3)
Light Assembly - Portable	(3.0)
Provision Assembly - Crew Survival	(51.6)
Personal Communications	(3.0)
TOTAL CREW SYSTEM (To be brought forward)	<hr/> 908.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTCOMMAND MODULEUSEFUL LOAD

ITEM	CURRENT WEIGHT 11-1-63
<u>REACTION CONTROL</u>	(270.0)
Usable Propellant	225.0
Residual Propellant	44.0
Trapped - System	30.8
Mixture Ratio	2.7
Expulsion Efficiency	7.8
Loading Tolerance	2.7
RCS Helium	1.0
<u>ENVIRONMENTAL CONTROL</u>	(167.0)
Lithium Hydroxide	112.0
Activated Charcoal	4.0
Containers for LiOH & Charcoal	12.5
Oxygen - Re-entry	3.7
Freon	10.0
Water-Boost Cooling	4.0
Water-Emergency Re-Entry Cooling	6.0
Water-PLSS Initiated Charge	6.8
Water-Earth Orbit Cooling & Drinking	4.0
Chemical Disinfectant	4.0
SCIENTIFIC EQUIPMENT	(250.0)
TOTAL This Page	687.0
TOTAL CREW SYSTEM (Brought forward from Page 47)	908.0
TOTAL USEFUL LOAD	1595.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULESUMMARY

ITEM		CURRENT WEIGHT 11-1-63
WEIGHT EMPTY		7460
Structure	2210	
Electronics	177	
Reaction Control	580	
Electrical Power	1363	
Environmental Control	92	
Propulsion	3038	
<u>USEFUL LOAD</u>		2230
Reaction Control	838	
Electrical Power	503	
Environmental Control	208	
Propulsion	681	
BURNOUT WEIGHT		9690
MAIN PROPELLANT		37295
GROSS WEIGHT		<u>46985</u>

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULESTRUCTURE

ITEM	CURRENT WEIGHT 11-1-63
<u>STRUCTURE</u>	
Basic Body Structure	(1644)
Honeycomb Panels - Shell	762
Radial Beams	380
Internal Structure and Eng. Compt. Closeout	43
Forward Bulkhead	155
Aft Bulkhead	304
Secondary Structure	(154)
Tank Support Shelf	33
Engine Support	41
Antenna Support	30
Heat Shields	50
Insulation	(253)
Separation Provisions and Attach	(16)
Fairing	(143)
TOTAL STRUCTURE	<hr/> 2210

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULEELECTRONIC SUBSYSTEM

ITEM		CURRENT WEIGHT 11-1-63
<u>ELECTRONICS SUBSYSTEM</u>		
Communications		(48.0)
High Gain Antenna		29.0
Antenna	12.2	
Gimbals	12.0	
Earth Sensor	4.8	
Antenna Boom		7.0
Antenna Locking Provisions		3.0
Coax		5.0
Coax Connectors		1.0
Supports		1.0
Wiring		2.0
Instrumentation		(129.0)
Sensors		30.0
Electrical Provisions		94.0
Supports		5.0
TOTAL ELECTRONICS SUBSYSTEMS		177.0

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ITEM	CURRENT WEIGHT 11-1-63
<u>REACTION CONTROL SYSTEM</u>	
Propellant Systems	(161.4)
Oxidizer System	80.5
Tanks & Expulsion Devices	28.8
Plumbing, Fittings & Insulation	8.5
Valves & Regulators	12.0
Sensors	3.0
Supports	18.2
Quantity Gaging	10.0
Fuel System	80.9
Tanks & Expulsion Devices	29.2
Plumbing, Fittings & Insulation	8.5
Valves & Regulators	12.0
Sensors	3.0
Supports	18.2
Quantity Gaging	10.0
Pressure System	(128.0)
Tanks (4500 psi)	19.0
Plumbing, Fittings & Insulation	6.0
Valves & Regulators	76.0
Sensors	7.0
Supports	20.0
Engine System	(150.4)
Engines	70.4
Reflectors & Insulation	80.0
Structural Provisions	(80.0)
Electrical Provisions	<u>(60.2)</u>
TOTAL REACTION CONTROL SYSTEM	580.0

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ITEM	CURRENT WEIGHT 11-1-63
<u>ELECTRICAL POWER</u>	
Fuel Cell Power System	(117.3)
Fuel Cell Power Pack (Incl. Mount Instrumentation)	753.0
Intermodular - Radiator Plumbing	26.7
Fuel Cell Module Mount Attach	2.0
Fuel Cell H ₂ System	
Subcontractor Components	137.8
Plumbing and Valves	4.0
Fuel Cell and ECS O ₂ System	
Subcontractor Components	168.2
Plumbing and Valves and Supports	27.1
Water Glycol - Fuel Cell Heat Transfer System	7.0
Elect. Wiring - Supercritical Gas	10.0
Space Radiator (Outer Skin)	24.7
Fuel Cell Module Stabilization Webs	3.8
Fuel Cell Plumbing Supports	8.0
Power Distribution	(71.2)
Electrical Transmission	40.0
Power Distribution Box	31.2
Electrical Common Utility	(119.5)
Electrical Transmission	41.0
Sequencer	28.0
Adapter Separation System	7.0
C/M to S/M Separation System	18.0
Pyrotechnic Initiation	12.0
Provisions	13.5
 TOTAL ELECTRICAL POWER	 1363.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTSERVICE MODULEENVIRONMENTAL CONTROL SYSTEM

ITEM	CURRENT WEIGHT 11-1-63
<u>ENVIRONMENTAL CONTROL SYSTEM</u>	
Water-Glycol Circuit	(75.0)
Subcontractor Valves & Controls	5.6
Plumbing and Hardware	22.1
Water - Glycol	10.0
Space Radiator (Outer Skin)	37.3
Water Supply System	(7.6)
Subcontractor Valves & Controls	.1
Plumbing and Hardware	7.0
Miscellaneous Brackets & Supports	.5
Oxygen Supply System	(3.0)
Plumbing and Supports	3.0
Common Items	(6.4)
Supports	6.4
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TOTAL ENVIRONMENTAL CONTROL SYSTEM	92.0

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ITEM	CURRENT WEIGHT 11-1-63
<u>MAIN PROPULSION</u>	
Propellant Systems	(1356.0)
Oxidizer System	759.3
Tanks & Doors	557.0
Skirts	59.8
Plumbing, Fittings & Insulation	53.0
Valves	4.5
Quantity Indication	25.5
Mixture Ratio Control	14.0
Supports - Plumbing & Equipment	45.5
Fuel Systems	596.7
Tanks & Doors	458.0
Skirts	33.2
Plumbing, Fittings & Insulation	42.0
Valves	4.5
Quantity Indication	25.5
Supports - Plumbing & Equipment	33.5
Pressure System	(925.0)
Tanks (4400 psi)	784.0
Tank Supports	30.0
Plumbing, Fittings & Insulation	24.0
Valves, Regulators & Heat Exchanger	49.0
Supports - Plumbing & Equipment	38.0
Engine System	(715.0)
Engine	690.0
Closeouts - Throat to S/M	25.0
Electrical Provisions	(42.0)
 TOTAL MAIN PROPULSION SYSTEM	 <hr/> 3038.0

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ITEM	CURRENT WEIGHT 11-1-63
<u>REACTION CONTROL</u>	(838.0)
RCS Propellant	835.0
Usable	790.0
Residual	45.0
Trapped System	4.0
Mixture Ratio	9.0
Expulsion Efficiency	24.0
Loading Tolerance	8.0
RCS Helium	3.0
<u>ELECTRICAL POWER (Normal Mission)</u>	(503.0)
Hydrogen - Supercritical Gas	58.5
Usable (Electrochemical Incl. Tolerance)	46.0
Unusable (Residual & Instrument Error)	3.2
Emergency Provisions	4.7
Expend (Leakage & Purge)	4.6
Oxygen - Supercritical Gas	444.5
Usable (Electrochemical Incl. Tolerance)	377.0
Unusable (Residual & Instrument Error)	17.5
Emergency Provisions	44.0
Expend (Leakage & Purge)	6.0
<u>ENVIRONMENTAL CONTROL (Normal Mission)</u>	(208.0)
Oxygen - Supercritical Gas	208.0
Usable (Metabolic)	76.5
Unusable (Residual & Instrument Error)	9.1
Emergency Provisions	25.3
Expend (Leakage, LEM, PLSS, Repress.)	97.1
<u>PROPULSION</u>	(681.0)
Main Propulsion Helium	99.0
Main Propellant Residuals	582.0
Trapped - System	225.0
Trapped - Engine	67.0
Mixture Ratio Tolerance	100.0
Loading Tolerance	190.0
<u>TOTAL USEFUL LOAD (Less Main Propellant)</u>	2230.0

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTLAUNCH ESCAPE SYSTEMSUMMARY

ITEM	CURRENT WEIGHT 11-1-63
<u>LAUNCH ESCAPE SYSTEM</u>	
Structure	(1062)
Tower Assy & Flap	348
Escape Motor Skirt	209
Pitch Motor Structure	155
Nose Cone and Ballast Support	114
Attaching Parts	10
Tower Insulation	216
Skirt Insulation	10
Separation Provision	(67)
Ballast	(518)
Propulsion	(5345)
Escape Motor	4764
Jettison Motor	434
Jettison Motor Skirt	92
Pitch Control Motor	55
Electrical Power	(58)
TOTAL LAUNCH ESCAPE SYSTEM	<hr/> 7050

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~~CONFIDENTIAL~~DETAIL WEIGHT STATEMENTADAPTERSUMMARY

ITEM	CURRENT WEIGHT 11-1-63
<u>ADAPTER</u>	
Structure	(3070)
Panels	2470
Frames	200
Thermal Insulation	400
Electrical Power	(80)
Separation System	(250)
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TOTAL ADAPTER	3400

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